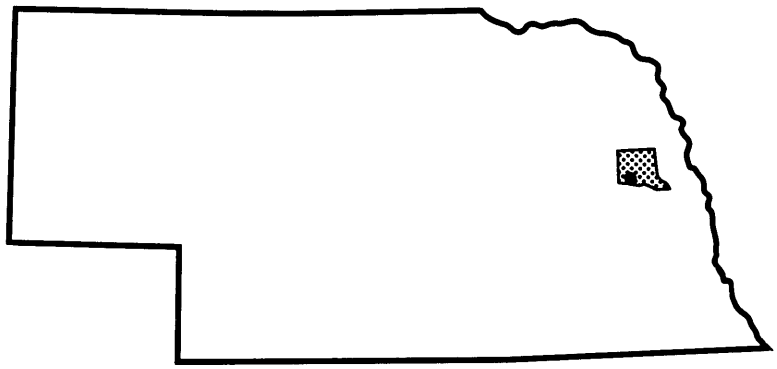
FLOOD INSURANCE STUDY

CITY OF NORTH BEND, NEBRASKA

DODGE COUNTY



SEPTEMBER 1979

FEDERAL EMERGENCY MANAGEMENT AGENCY
FEDERAL INSURANCE ADMINISTRATION

COMMUNITY NUMBER – 310239

TABLE OF CONTENTS

TABLE OF CONTENTS - continued

FLOOD INSURANCE STUDY

CITY OF NORTH BEND, DODGE COUNTY, NEBRASKA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of North Bend, Dodge County, Nebraska, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the City of North Bend to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 24 CFR, 1910.1 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Geological Survey for the Federal Insurance Administration, under Inter-Agency Agreement No. IAA-H-8-76, Project Order No. 1, Amendments 1 through 4. This study was completed in June 1978.

1.3 Coordination

Officials of the North Bend City Council met in January 1975 with personnel of the U.S. Geological Survey (USGS) and the FIA Consultation Coordination Officer to select a community base map and to identify the stream requiring a detailed study. The Nebraska Coordinating Officer was contacted occasionally throughout the course of this study. Hydrologic analyses for the Platte River were coordinated with those of the U.S. Army Corps of Engineers (COE), Omaha District. Possible conflicts were eliminated by written communication with the COE. The hydrologic and

hydraulic analyses for the Platte River were also coordinated with a private consulting firm, Henningson, Durham and Richardson. All possible conflicts were eliminated by written or personal contact.

Preliminary results of the study were presented to the North Bend City Council at the intermediate coordination meeting held on March 16, 1978, by representatives of the FIA, the USGS, and the State Coordinator of the Nebraska Natural Resources Commission. On November 30, 1978, the results of the study were reviewed and accepted at the final coordination meeting attended by representatives of the Study Contractor, the FIA, the State Coordinator, and community officials.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of North Bend and the one mile area of extraterritorial jurisdiction within Dodge County. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction for the next five years, through June 1983. The scope and methods of study were proposed to and agreed upon by the FIA and the City of North Bend.

Flooding caused by the overflow of the Platte River within the extraterritorial boundaries of the city were studied in detail.

2.2 Community Description

The City of North Bend is on the north side of the Platte River which forms the southern border of Dodge County, which is in the east-central part of Nebraska. North Bend has a population of 1,350 (1970 census). The predictions are for the population to remain fairly stable for at least the next 20 years. North Bend is considered a second-class city with mayor/council-type government. The city is bounded on all sides by the unincorporated areas of Dodge County. The surrounding communities include Rogers, 7 miles west; Schuyler, 15 miles west; Columbus, 33 miles west; Ames, 8 miles east; and Fremont, 15 miles east. All the communities listed above border the Platte River on the north. Fremont is the largest city in Dodge County.

The average annual precipitation of the east-central division of Nebraska is 28.4 inches and the average annual temperature is 50.9 degrees Fahrenheit (Reference 1).

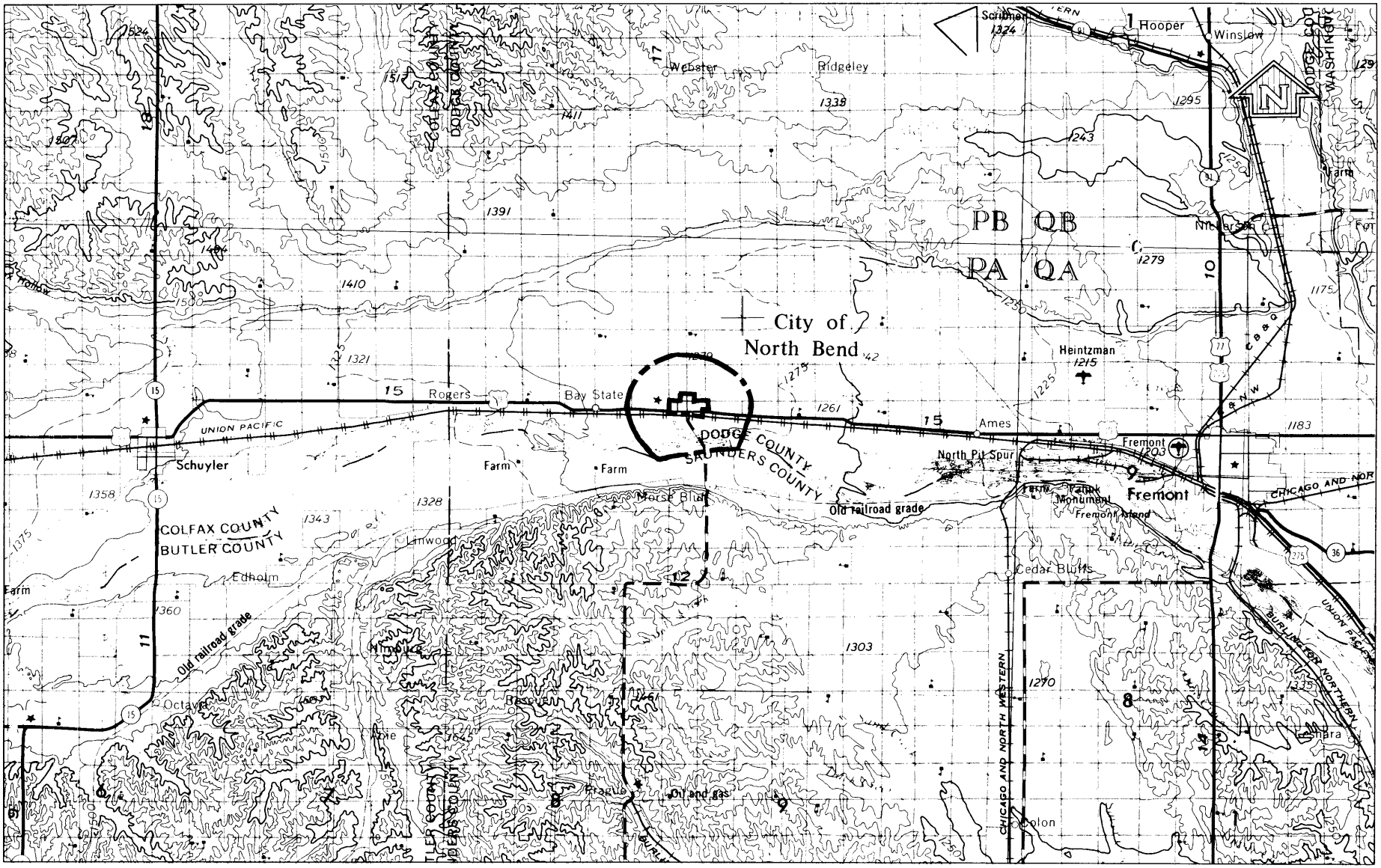


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF NORTH BEND, NB
(DODGE CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

Most soils in Dodge County are silt, loam, or clay, with some sand on the bottom lands. There are areas of silty clay alluvium in the larger valleys, and close to the river the alluvium is sandy loam, sand, or gravelly sand derived mostly from upgradient areas. The broad valley of the Platte River receives some addition of material when it is overflowed by runoff from the adjacent uplands. The areas adjacent to the river channel are occasionally overflowed. Scour and deposition both occur during overflow. The river carries a heavy sediment load at times and when, at flood stage, scour causes shifting and not removal of material in the channel, while both fine and coarse material is added to the area of overflow.

Commerce and industry are important in and around Fremont. However, farming and agribusiness are the leading occupations in Dodge County. The flood plains of North Bend consist primarily of residential and agricultural development with light industrial development.

2.3 Principal Flood Problems

Past history of flooding for the Platte River at North Bend indicates that all damage-producing floods have occurred in the spring. They were the result of ice jams developing in the channel and somewhere in the reach of the river from just downstream from the State Highway 79 bridge to approximately three miles upstream. The ice jams cause backwater in the channel which in turn forces water out of the channel and across the flood plain. Although the city is not inundated during usual flooding, during ice jamming the entire community becomes inundated.

From recollection of some residents, as verified by the mayor of North Bend, the greatest flooding of record occurred in March 1912 from ice jams in the river upstream from the town, a distance of two to 2.5 miles.

Past experience has shown that ice jam floods have occurred more often and caused considerably more damage to North Bend than open-water floods. A report on the 1960 floods (Reference 2) and aerial photos of a recent flood, March 1978 (Reference 3), were used to help define the area inundated by ice jam floods. Ice jams occurring in the main channel raise the water level to a sufficient height to allow overflow of the levees, which in turn causes breaks in the levees, or forces water out of the main channel a few miles upstream, which can, in turn, flow down the flat overflow plain and inundate all or part of North Bend itself.

The most recent damaging ice jam flood on record occurred in March 1960 when channel ice jams forced water out of banks some distance above North Bend, which in turn inundated most of the city. Prior to 1978, the highest stage of 1,274.56 feet was reached at the stream gaging station on the left upstream bank of the State Highway 79 bridge during the ice jams of February 1971. Minimal damage was suffered during this flood. An ice jam occurred during March 1978 just downstream from a new bridge on State

Highway 79, which resulted in stages approximately 3.4 feet higher than in 1971 but did not cause nearly as much damage to the town as did the 1960 ice jam flood.

Other high water periods occur during the summer months, usually in May or June, but have occurred as late as August. These floods are the result of heavy thunderstorm activity in the Loup River basin or upper reaches of the Platte River basin.

2.4 Flood Protection Measures

The following is quoted from correspondence between the City of North Bend and the Omaha District COE.

> "Response to a request from the city of North Bend, dated May 23, 1969, the Omaha District made a reconnaissance investigation of a flood problem on the Platte River at North Bend, Nebraska. The investigation was made under provisions of Section 205 of the 1948 Flood Control Act, as amended.
>
> The reconnaissance study indicated that levees along the south, west, and north sides of the urban area would be the best method of providing protection to North Bend. The total cost of the project was estimated to be $969,000. Of this total about $42,000 would be local costs.
>
> In 1969 an emergency levee, 9,000 feet long, was constructed upstream from North Bend on the left bank of the Platte River. In February 1971 this levee was extended downstream a distance of 8,435 feet to State Highway 79, under authority of Operation Foresight. Contacts with local officials indicate that no further flood control works are necessary under authority of Section 205 of the 1948 Flood Control Act, as amended. Further studies under this authority have been terminated."

The levee system just upstream from State Highway 79 was inspected by a USGS employee accompanied by the Mayor of North Bend in July 1976. The crest of the levee appeared to be 8 to 10 feet above the surrounding ground-surface elevation. This part of the levee was constructed out of soft, fine sand dozed up from the old streambed. The Mayor indicated that the first 9,000 feet of the levee built in 1969 was of a heavier, more compactable soil and the grass seeded on the side slopes had grown and matted quite well. The Mayor also indicated that at some time after the emergency levee was completed on the left bank in 1971, an existing levee along the right-bank was raised to conform to the elevation of the levee on the left-bank. The levee along the right-bank is in a different county and not within the territorial limits of North Bend. It would, however, have an effect on the

flow of the river for the higher floods. It should be noted that both the left-bank and right-bank levees were overtopped by the ice jam flood of March 1978.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten), and for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for the flooding source studied in detail affecting the community.

The streamflow gaging station on the Platte River at North Bend (no. 06796000) was the principal source of data for defining discharge-frequency relationships. The entire 27-year period of record, 1949 to 1975, was used for computation purposes. This analysis followed the standard log-Pearson Type III method as outlined by the U.S. Water Resources Council (Reference 4).

The 10-, 50-, and 100-year frequency discharges as computed in the Nebraska Platte River Level B study compared favorably with the discharges presented in this study (Reference 5).

Peak discharges for the 10-, 50-, 100-, and 500-year floods of the flooding source studied in detail in the community are shown in Table 1.

TABLE 1: SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK-DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
PLATTE RIVER					
Gage no. 06796000 in North Bend on State Highway 79	77,100	58,900	100,100	121,500	182,100

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community are carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along the flooding source studied in detail.

Cross section data were obtained from the private consulting firm of Henningson, Durham and Richardson (Reference 6). The cross sections were developed through the use of photogrammetry. The below-water sections were obtained by field measurement. One highway bridge and road (State Highway 79) crossed the study reach. The road profile and bridge were surveyed in the field to obtain elevation data and structural geometry. A new bridge was completed in the late fall and early winter of 1974 and is approximately 50 feet downstream from the previous bridge.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel Roughness factors (Manning's "n") used in the hydraulic computation were chosen by engineering judgment and were based on field observations of the river and flood plain areas. Roughness values for the main channel of the Platte River range from 0.017 to 0.023 with flood plain roughness values ranging from 0.045 to 0.10 for all floods.

Starting water-surface elevations were determined in accordance with the Dodge County Flood Insurance Study which was already in progress (Reference 6). Water-surface elevations of floods of the selected recurrence intervals were computed through the use of the USGS step-backwater program (Reference 7). Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1). Starting and ending water-surface elevations were correlated with those developed by Henningson, Durham and Richardson.

The two-foot average depth assigned to the sheet flow flooding caused by ice jams was determined from local residents and historical information.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using topographic maps at a scale of 1:24000, with a contour interval of five feet (Reference 8).

The river forms the divide between Dodge County and Saunders County. The actual boundary line follows the right (south) bank of the river quite closely. The right-bank 100-and 500-year flood boundaries are, therefore, not in Dodge County and are, subsequently, not under the jurisdiction of the City of North Bend.

The historic ice jam flood boundary around and to the north of the City of North Bend was developed from information furnished by local citizens, information contained in the USGS Water-Supply Paper 1790-A (Reference 2), and aerial photographs taken during the most recent ice jam flood of March 1978 (Reference 3).

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to

limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

The floodway in this study was adjusted at the downstream end of the study to coincide with the floodway from the Dodge County Flood Insurance Study (Reference 6). The right floodway line was placed to follow the river bank from the downstream end of the study to State Highway 79 and then follow the right-bank levee upstream from the highway. The left floodway line was arbitrarily placed to follow the levee at the downstream end of the study, to follow a smooth transition to the left abutment of the bridge, and to follow the levee upstream of the highway. The results of these floodway placements were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2). Portions of the floodway extend beyond the extraterritorial limits.

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
PLATTE RIVER							
A	25,540	3052	16,321	7.4	1267.6	1267.6	0.0
B	28,740	1715	10,777	11.3	1270.9	1270.5	0.4
C	29,990	1629	11,632	10.4	1272.5	1272.0	0.5
D	30,660	1470	12,659	9.6	1273.5	1273.3	0.2
E	32,670	1731	9510	12.8	1274.8	1274.8	0.0
F	35,950	3359	21,221	5.7	1279.5	1279.5	0.0
G	38,900	4220	11,706	10.4	1280.5	1280.5	0.0

[1]FEET ABOVE COTTERELL–PLATTE TOWNSHIP BOUNDARY
[2]THIS WIDTH EXTENDS BEYOND EXTRATERRITORIAL LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF NORTH BEND, NB
(DODGE CO.)

FLOODWAY DATA

PLATTE RIVER

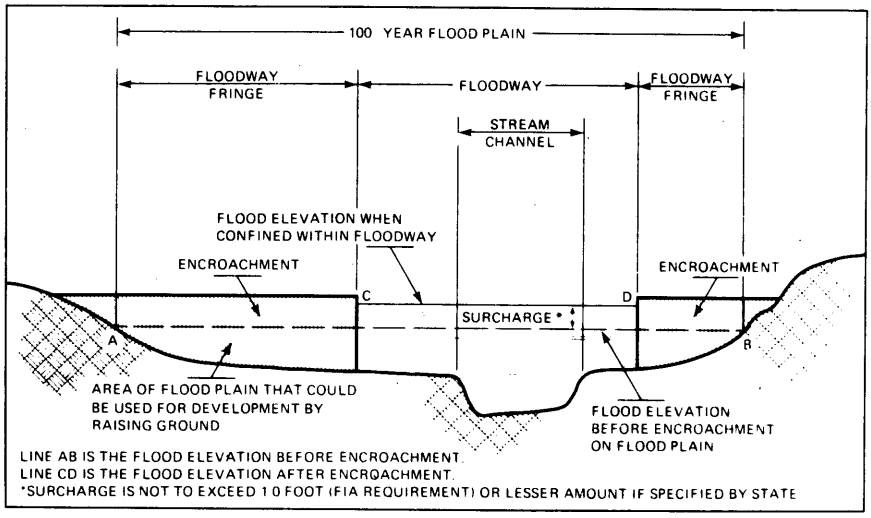


FIGURE 2. Floodway Schematic

The floodways in this report are recommended to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF), and flood insurance zone designations for each flooding source affecting the City of North Bend.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot

5.2 Flood Hazard Factors

The FHF is used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire area within the extraterritorial limits of the City of North Bend was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A0:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown; but no FHFs are determined.
Zones A3, A5:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations are shown, and zones subdivided according to FHF.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of North Bend is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

Discharge values presented in the Nebraska Platte River Level B study are in agreement with this study (Reference 5). A Flood Insurance Study is in progress for the unincorporated areas of Dodge County, Nebraska (Reference 6). All flood elevations, flood boundaries, and floodways were correlated with the Dodge County study.

A Flood Hazard Boundary Map has been published by the Federal Insurance Administration (Reference 9). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic and other pertinent data used in this study can be obtained by contacting the office of the Federal Insurance Administration, Regional Director, 911 Walnut Street, Kansas City, Missouri 64106.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
PLATTE RIVER							
REACH 1	0003, 0004	−1.5	−0.5	1.2	015	A3	VARIES–SEE MAP
REACH 2	0003, 0004	−2.3	−0.8	1.2	025	A5	VARIES–SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
CITY OF NORTH BEND, NB
(DODGE CO.)

FLOOD INSURANCE ZONE DATA

PLATTE RIVER

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3. Air National Guard, Aerial Photographs, Scale 1:5600: North Bend, Nebraska, March 17, 1978.

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5. Missouri River Basin Commission, Platte River Basin, Nebraska, Level B Study, Flood Damage and Control & Hydrology and Hydraulics Technical Paper, September 1975.

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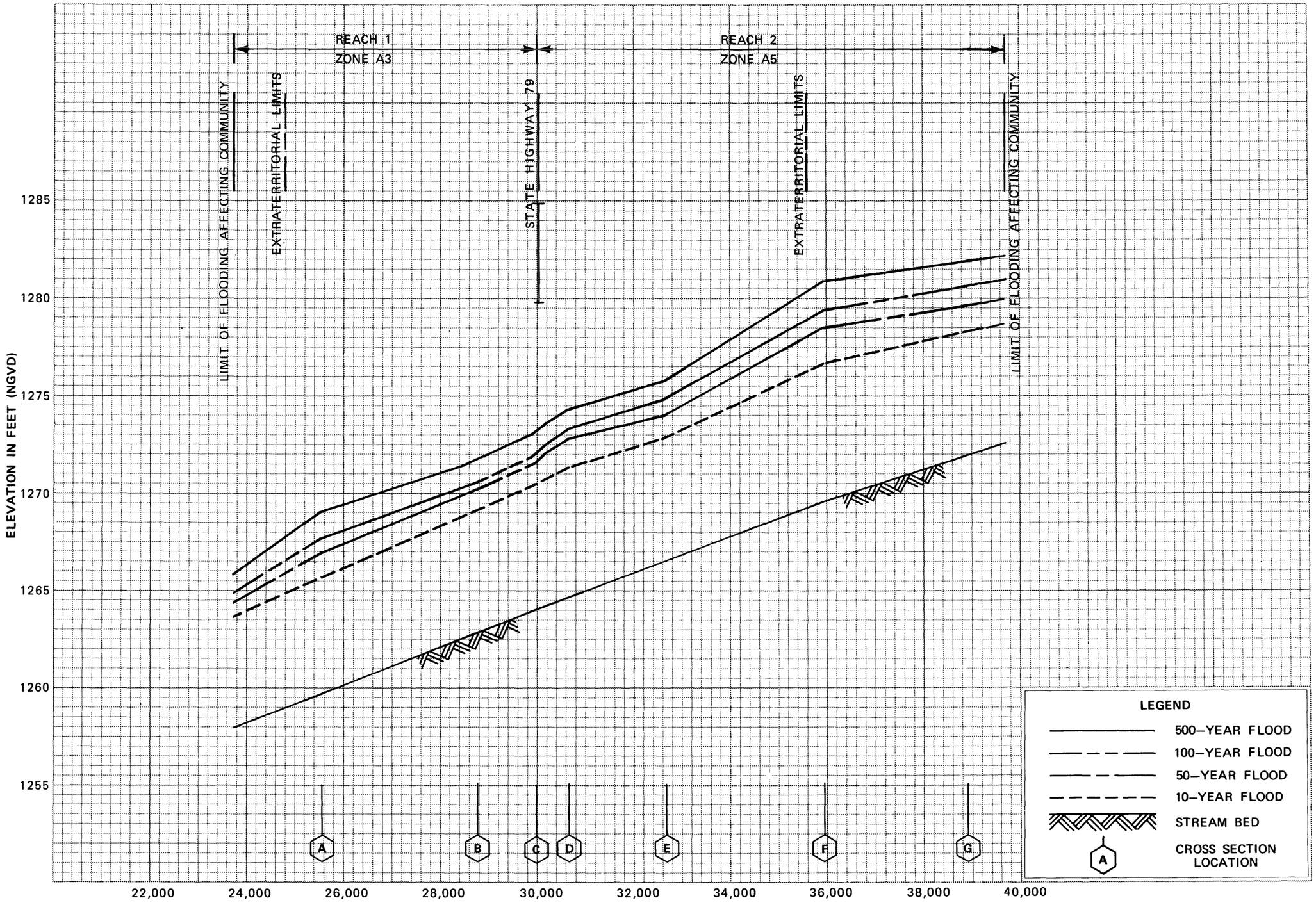
8. ----------, 7.5 Minute Series Topographic Maps, Scale 1:24000, Contour Interval five feet: North Bend, Nebraska, 1968.

9. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of North Bend, Nebraska, July 1974, (revised) January 1976.



FLOOD PROFILES

PLATTE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF NORTH BEND, NB
(DODGE CO.)

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